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Epidemiology of pediatric injury in Malawi: Burden of disease and implications for prevention

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ABSTRACT

Purpose: Pediatric injuries pose a significant health burden in sub-Saharan Africa, though historic data are too scarce to appreciate the extent of the problem. The purpose of this study is to utilize a comprehensive database to describe the epidemiology of pediatric injuries at a tertiary hospital in Malawi.

Methods: Data were prospectively collected on patients presenting to the emergency department for treatment of injuries from 2008 to 2010 (n = 23,625). The subset of pediatric patients (n = 7233) underwent cross-sectional analysis to examine demographics, injury environment, timing and mechanisms.

Results: Pediatric patients, (0–16 years) comprised 30.6% of all trauma patients. Mean age was 7.2 years. Falls were the most common injury (43%), followed by burns (11.1%), pedestrian road traffic injuries (9.7%), foreign bodies (7.5%), and assaults (7.2%). Statistically significant differences in injury pattern were observed between gender, age groups and season. After logistic regression, predictors of fall included male gender, home setting, and rainy season, whereas predictors of burn included female gender, age 0–5 yrs, home setting, and cold season. Predictors of pedestrian injury included age 6–10 yrs, female, and roadside setting. Predictors of foreign body ingestion included age 0–5 yrs, female gender, home setting, and daytime, and predictors of assault include male gender, age 11–16 yrs, nighttime hours. All predictors were statistically significant ($p < 0.05$).

Conclusions: This study revealed patterns of injury based upon age, gender, location, and season. Our results may prove useful to stakeholders in injury prevention for designing, evaluating, and implementing programs to improve public safety in children in Malawi and similar resource poor nations.

1. Introduction

Pediatric trauma is largely absent from child survival initiatives presently on the global agenda, though it is a common cause of morbidity and mortality in Africa.[1] Trauma is the most likely cause of death in children who survive the first five years, and this continues until the fourth decade of life.[2] In some countries, the mortality from pediatric injuries is more than 50%.[3] More than 95% of pediatric injury deaths occur in low-income and middle-income countries (LMIC), where in children over the age of 5 years, trauma causes more deaths than HIV, malaria, and tuberculosis combined.[4–6]

Injuries are also the most common surgical problem affecting children in sub-Saharan Africa, accounting for the highest percent of pediatric surgical admissions, and causing the greatest number of inpatient hospital days (49.1%), surgical deaths (48%), and life-long disability.[2,6,7] Disability Adjusted Life Years (DALYs) related to injury are highest in children in sub-Saharan Africa, where 46% of the 1 billion people are under the age of 14 years. This is significant, as the number of DALYs lost in sub-Saharan Africa are the greatest in the world. Sub-Saharan Africa contains 11% of the world's population and bears over 24% of the global burden of disease.[8] However, it employs only 3% of the global health workforce and spends less than 1% of the world's financial resources on health.[9]

Nongovernmental organizations such as the World Health Organization and UNICEF historically do not address surgical care in developing countries due to the perception of high cost and

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limited benefits.[10–12] Communicable diseases traditionally receive more funding ($2–3/DALY lost to major infectious diseases), which allows for a more established system of prevention and care with better data collection infrastructure. Surgical diseases, led by traumatic injury, suffer from under-reporting and under-funding in comparison, with only $0.06/DALY lost to injury allocated to the health sector of less-developed countries.[12] Even in the largest synthesis of global data repositories—the Global Burden of Disease model, based upon 8700 datasets, fewer than 1000 contained data related to injury. Of those datasets used, less than 25% were from sub-Saharan Africa.[13] The need for a systematic epidemiologic data collection strategy in LMIC, particularly those in sub-Saharan Africa is imperative.[14]

Malawi is representative of the sub-Saharan region, ranking 171 out of 187 countries in Human Development Indices.[15] However, the quantifiable disease burden of pediatric injury is unknown, as injury-specific epidemiologic data collection in Malawi is scarce in comparison to communicable diseases.

Therefore to further delineate the characteristics of the pediatric injury epidemiology in Malawi, we sought to utilize a hospital-based trauma registry dataset to describe the patterns of injuries, specifically measuring the role of gender, age and season. By quantifying the amount and patterns of injury, we intend to contribute to the global repository of data used for calculating Burden of Disease (BoD) and prioritize needs in Malawi.

2. Methods

This study was conducted at Kamuzu Central Hospital (KCH), in Lilongwe, Malawi, with a retrospective analysis of prospectively collected, hospital-based trauma registry data described previously.[16] All pediatric patients, age 0–16 years, presenting to the KCH casualty ward between July 2008 through December 2010 were included in the analysis ($n = 7233$). Demographic and injury specific data were collected at the time of admission. The data collection and analysis were approved by both the Institutional Review Board at UNC, and the Malawian National Health Sciences Research Committee (NHSRC).

Data were analyzed using excel and STATA v11 statistical software. Univariate analysis was performed to describe the distribution and general characteristics of the study population. Age was analyzed both as a continuous variable and subsequently as a categorical variable in age cohorts of 0–5 years, 6–10 years, and 11–16 years. Included in the univariate analysis were calculations of means (continuous variables), and percents (categorical variables). Bivariate analysis of injury characteristics included associations of age, gender, and season to injury mechanism, injury setting, type, time of day, transport used to travel to the hospital, and disposition (whether admitted or treated as an outpatient). Analysis included Pearson's Chi square and student's *T*-test to evaluate potential associations. Independent predictors of the most common injury mechanisms (falls, burns, and pedestrian injuries) were assessed using logistic regression, and reported as adjusted odds ratios (OR).

3. Results

There were a total of 7233 patients from age 0–16 years that presented to the KCH casualty department with injury in the study period. This represented 30.6% of all trauma patients. General characteristics are included in Table 1. Males represented 63% of the patients ($n = 4566$). Mean age was 7.2 years (SD 4.5), with a preponderance of children age 0–5 years (42%, $n = 3046$). Most of the injuries occurred in the home (65.9%, $n = 4769$), with 15.0% ($n = 1085$) occurring on the road and only 5.2% ($n = 378$) at school. Most patients were brought in to the hospital by a minibus (40.5%, $n = 2931$) or by private vehicle (33.1%, $n = 2393$), with only 14.7% ($n = 1061$) arriving by ambulance.

The most common mechanism of injury was falls (43.2%, $n = 3125$), followed by burns (11.1%, $n = 803$). Though road traffic injuries (RTIs) involving pedestrians were the third most common mechanism of injury (9.7%, $n = 700$), RTIs involving passengers or drivers in vehicles or on bicycles were uncommon, and comprised less than 5% of the injuries. Injuries from foreign bodies made up 7.5% ($n = 539$), and assaults numbered 520 (7.2%). Injuries from animal bites and collapsed structures combined made up less than 10% ($n = 638$) of the injuries (Table 1).

Table 1
Results of univariate analysis, describing general characteristics of the total population. Results are expressed as mean for the continuous variable age, and percents for categorical variables.

Injury characteristics	n (total $n = 7233$)	Percent of total or mean (SD)
Mean age-total	7233	7.2 (SD 4.5)
Gender		
Male%	4566	63.1
Female%	2645	36.6
Missing	22	0.3
Injury mechanism		
Fall	3125	43.2
Burn	803	11.1
RTI-pedestrian	700	9.7
Foreign body	539	7.5
Assault	520	7.2
Animal bite	323	4.5
Collapsed structure	315	4.4
Passenger	228	3.2
Other	563	7.8
Missing	117	1.6
Injury setting		
Home	4769	65.9
Road	1085	15.0
School	378	5.2
Sport	141	2.0
Other	253	3.5
Missing	607	8.4
Disposition		
Outpatient	6169	85.3
Admitted	872	11.4
Died prior to admission	63	0.9
Missing	131	1.8
Injury type		
Contusion	1800	24.9
Fracture	1567	21.7
Laceration	1191	16.5
Burn	798	11.0
Foreign body	526	7.3
Other	1195	16.5
Missing	156	2.2
Injury season		
Rainy (Dec–Feb)	1642	22.7
Lush, green (Mar–May)	1546	21.4
Cold, dry (June–Aug)	1790	24.8
Hot, dry (Sept–Nov)	2221	30.7
Missing	34	0.5
Time of day		
Morning (06:00–07:59)	499	6.9
Day (08:00–17:59)	5189	71.7
Evening (18:00–19:59)	1026	14.2
Night (20:00–05:59)	419	5.8
Missing	100	1.4
Transport to hospital		
Minibus	2931	40.5
Private vehicle	2393	33.1
Ambulance	1061	14.7
Walked	536	7.4
Police	86	1.2
Bicycle	61	0.8
Other	80	1.1
Missing	85	1.2

3.1. Age-based patterns of injury

Injury mechanism varied by age, in that younger patients had higher rates of burn injury (0–5 yr, 20.2% vs 6–10 yrs, 5.5% and 11–16 yrs, 3.2%, $p < 0.001$) and ingestion of foreign bodies (0–5 yrs, 11.8%, vs 6–10 yrs, 5.6% and 11–16 yrs, 3.1%, $p < 0.001$), but lower rates of animal bites (0–5 yrs, 2.7%, vs 6–10 yrs, 5.9% and 11–16 yrs, 5.6%, $p < 0.001$) and assault (0–5 yrs, 3.2%, vs 6–10 yrs, 5.2% and 11–16 yrs, 16.5%, $p < 0.001$), when compared to older children. Those patients sustaining falls had a higher percent within the 6–10 year group (49.2%), as compared to those 0–5 years (40.8%) and 11–16 years (39.3%) age range ($p < 0.001$) (Table 2). This pattern of the 4 most common injury mechanisms can be visualized in Fig. 1 with age as a continuous variable.

Younger children were also more likely to be injured at home (0–5 yrs, 78.7% vs 6–10 yrs, 64.1% and 11–16 yrs, 47.1%, $p < 0.001$), whereas older children were more likely to be injured on the road (11–16 yrs, 22.3% vs 6–10 yrs, 16.7% and 0–5 yrs, 9.3%, $p < 0.001$) or at school (11–16 yrs, 9.7% vs 6–10 yrs, 6.5% and 0–5 yrs, 1.5%, $p < 0.001$). There was a higher percentage of younger children (0–5 yrs) and adolescents (11–16 yrs) injured in the evening than the 6–10 yr group (0–5 yrs, 15.5% and 11–16 yrs, 14.4% vs 6–10 yrs, 12.4%, $p < 0.001$). There was not a significant difference in the age of those who were admitted to the hospital, treated as an outpatient, or who died prior to or at arrival to the hospital (Table 2).

3.2. Gender and injury characteristics

Females were statistically significantly more likely to sustain burn injury (13.5% vs 9.6%, $p < 0.001$) and ingest or inhale foreign bodies (9.3% vs 6.4%, $p < 0.001$) Fig. 2. Females were slightly more

Table 2
Characteristics of patients presenting in age categories of 0–5 years, 6–10 years, and 11–16 years.

Injury characteristics	Percent 0–5 years (n) n = 3046	Percent 6–10 years (n) n = 2354	Percent 11–16 years (n) n = 1833	p value*
Injury mechanism				
Fall	40.8% (1244)	49.2% (1160)	39.3% (721)	<0.001
Burn	20.2% (614)	5.5% (130)	3.2% (59)	<0.001
Pedestrian	7.1% (216)	12.7% (300)	10.0% (184)	<0.001
Foreign body	11.8% (353)	5.6% (129)	3.1% (57)	<0.001
Assault	3.2% (96)	5.2% (121)	16.5% (303)	<0.001
Animal bite	2.7% (81)	5.9% (139)	5.6% (103)	<0.001
Other	12.8% (390)	14.4% (339)	19.9% (365)	
Missing	1.4% (43)	1.5% (36)	2.1% (38)	
Injury setting				
Home	78.7% (2397)	64.1% (1508)	47.1% (864)	<0.001
Road	9.3% (283)	16.7% (394)	22.3% (408)	<0.001
School	1.5% (46)	6.5% (154)	9.7% (178)	<0.001
Other	2.6% (79)	3.7% (87)	12.5% (229)	
Missing	7.9% (242)	9.0% (211)	8.4% (154)	
Injury type				
Contusion	24.5% (746)	22.9% (538)	28.2% (516)	<0.001
Fracture	17.1% (521)	26.9% (632)	22.6% (414)	<0.001
Laceration	12.1% (368)	19.3% (455)	20.1% (368)	<0.001
Burn	20.0% (608)	5.5% (129)	3.3% (61)	<0.001
Foreign body	11.6% (353)	5.2% (122)	2.8% (51)	<0.001
Other	12.9% (393)	18.2% (428)	20.0% (367)	
Missing	1.8% (54)	2.0% (48)	3.0% (54)	
Time of day				
Morning (06:00–07:59)	7.1% (215)	7.0% (164)	6.6% (120)	0.8
Day (08:00–17:59)	71.5% (865)	75.5% (1778)	68.9% (1263)	<0.001
Evening (18:00–19:59)	15.5% (472)	12.4% (291)	14.4% (263)	0.004
Night (20:00–05:59)	5.3% (162)	3.8% (90)	9.1% (167)	<0.001
Missing	1.6% (49)	1.3% (31)	1.1% (20)	
Disposition				
Outpatient	84.9% (2587)	86.1% (2026)	84.9% (1556)	0.4
Admitted	12.7% (388)	11.2% (264)	12.0% (220)	0.2
Died prior to admission	0.7% (21)	1.0% (24)	0.9% (16)	0.4
Missing	1.6% (50)	1.7% (40)	2.2% (41)	

*p value represents two-sided alpha denoting significance from chi^2.

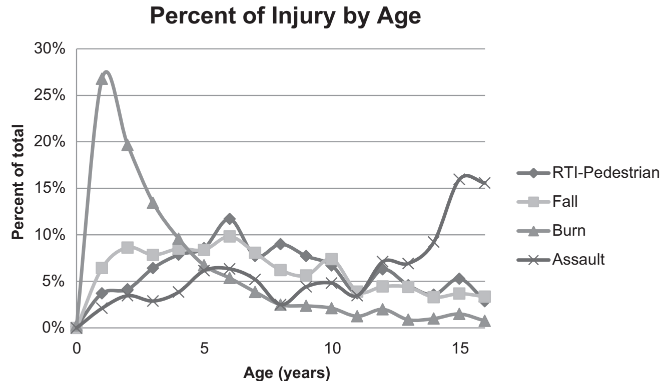

Fig. 1. Frequency (expressed as percent of the total population) of different injury mechanisms distributed over the age range of 0–16 years.

likely to sustain these injuries in the home (68.7% vs 64.3%, $p < 0.001$) but much less likely during sport (0.5% vs 2.7%, $p < 0.001$), than their male counterparts. Males were statistically significantly more likely to experience falls (45.1% vs 39.9%, $p < 0.001$) or assaults (8.1% vs 5.7%, $p = 0.002$), with their injury types more likely to be fractures (23.3% vs 19.1%, $p = 0.001$) and lacerations (17.8% vs 14.3%, $p = 0.002$). There was a higher percentage of females injured in the morning hours than males (8.1% vs 6.2% respectively, $p = 0.003$), and more males during the day (males 73.3% vs females 69.2%, $p < 0.001$) (Table 3).

3.3. Seasonality

The most dramatic differences, both clinically and statistically, in seasonal variation of injury patterns in Malawi occur between the cold, dry season (June–August) and the warm, rainy season (December–February). There was increased frequency of falls in the months corresponding to the warm, rainy season (47.6 vs 39.7–44.3 (other seasons), $p < 0.001$) (Fig. 3), whereas burn injury was more frequent in the colder months (15.0% vs 8.3%–10.9% (other seasons), $p < 0.001$) (Fig. 3). There was an increase in roadside injuries in the cold, dry time of year (17.3%) compared to other seasons (12.2–15.9%), ($p < 0.001$). Transport to the hospital was more likely to be by minibus in the more rainy seasons (43.1%) than in the dry seasons (38.6%, 38.5%) ($p = 0.003$), whereas those who walked to the hospital comprised a greater percentage of the

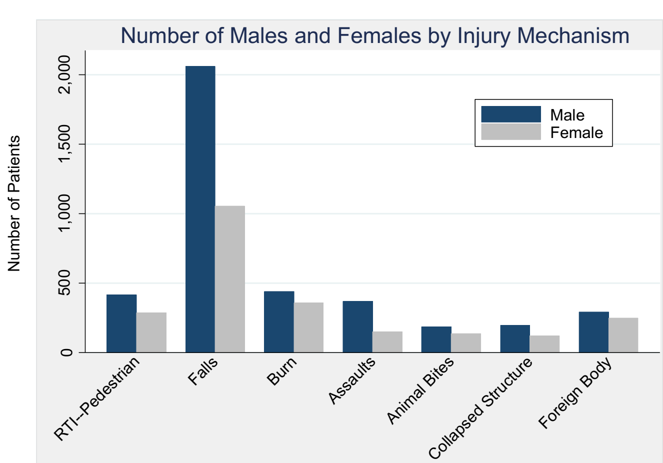

Fig. 2. Number of patients sustaining injuries via different mechanisms, stratified by gender.

Table 3
Association between gender and general characteristics of injury pattern and presentation.

Injury characteristics	%Male (n) Total $n = 4566$	%Female (n) Total $n = 2645$	p value*
Injury mechanism			
Fall	45.1% (2061)	39.9% (1055)	<0.001
Burn	9.6% (438)	13.5% (358)	<0.001
Pedestrian	9.1% (414)	10.8% (285)	0.08
Foreign body	6.4% (292)	9.3% (247)	<0.001
Assault	8.1% (369)	5.7% (150)	0.002
Animal bite	4.1% (185)	5.1% (135)	0.04
Other	15.8% (721)	14.3% (378)	
Missing	1.8% (81)	1.4% (36)	
Injury setting			
Home	64.3% (2934)	68.7% (1818)	0.001
Road	15.5% (706)	14.3% (378)	0.4
School	5.0% (229)	5.6% (147)	0.8
Sport	2.8% (127)	0.5% (14)	<0.001
Other	3.9% (178)	2.7% (71)	
Missing	8.5% (388)	8.2% (217)	
Injury type			
Contusion	24.8% (1131)	25.1% (664)	0.9
Fracture	23.2% (1060)	19.1% (504)	0.001
Laceration	17.8% (811)	14.3% (378)	0.002
Burn	9.6% (440)	13.3% (351)	<0.001
Foreign body	6.3% (289)	9.0% (237)	0.001
Others	16.1% (735)	17.1% (452)	
Missing	2.2% (101)	2.1% (55)	
Injury season			
Rainy	23.4% (1068)	21.3% (563)	0.04
Lush	21.5% (980)	21.3% (563)	0.9
Cold, dry	24.1% (1098)	25.9% (686)	0.07
Hot, dry	30.6% (1399)	31.0% (820)	0.7
Missing	0.5% (21)	0.5% (13)	
Time of day			
Morning (06:00–07:59)	6.2% (284)	8.1% (213)	0.003
Day (08:00–17:59)	73.3% (3345)	69.2% (1829)	<0.001
Evening (18:00–19:59)	13.6% (620)	15.3% (405)	0.04
Night (20:00–05:59)	5.5% (252)	6.2% (164)	0.2
Missing	1.4% (65)	1.3%5 (34)	
Disposition			
Outpatient	84.5% (3858)	86.6% (2291)	0.09
Admitted	12.6% (576)	11.1 (294)	0.09
Died prior to admission	0.85 (39)	0.83 (22)	0.4
Missing	2.0% (93)	1.4% (38)	

*p value represents two-sided alpha denoting significance from chi^2.

patients in the cold, dry season (9.7%), vs the other 3 seasons (6.3%–7.4%, $p < 0.001$). Ambulances brought 15.2%–16.3% of patients in the dry seasons (Jun–Nov), vs only 12.6%–13.8% of patients in the wet seasons (Dec–May) ($p = 0.005$) (Table 4).

3.4. Logistic regression

A full list of independent predictors of the five main mechanisms of injury in our population (Falls, Burns, Pedestrian RTI, Foreign Body ingestion, and Assaults) are found in Table 5. The strongest predictor of sustaining an injury during a fall is being at home (OR 2.6, 95%CI 2.3–2.9), and to a lesser extent are age 6–10 years (OR 1.4, 95%CI 1.3–1.6), male gender (OR 1.3, 95%CI 1.1–1.4), the rainy season (OR 1.2, 95%CI 1.1–1.4), and daytime hours (OR 1.8, 95%CI 1.6–2.0). Strong predictors of burn injury are age 0–5 years (OR 4.0, 95%CI 3.4–4.8), and being at home (OR 7.3, 95%CI 5.0–10.6), but also include female gender (OR 1.3, 95%CI 1.1–1.5), and the cold, dry season (OR 1.6, 95%CI 1.3–1.9).

Pedestrian injuries largely occur at a roadside setting (OR 50.9, 95%CI 40.5–63.9). There is an increased odds of sustaining a pedestrian injury in the 6–10 year age group (OR 1.4, 95%CI 1.1–1.8) and being female (OR 1.4, 95%CI 1.1–1.7). Female children (OR 1.5, 95%CI 1.2–1.7), age 0–5 years (OR 2.1, 95%CI 1.7–2.6), at home (OR 3.8, 95%CI 2.7–5.4), during the day (OR 1.3, 95%CI 1.0–1.6) had the highest odds of ingesting or inhaling a foreign body.

The strongest predictors of assault in our population was age 11–16 (OR 4.9, 95%CI 4.0–6.0) and nighttime hours (OR 2.7, 95%CI 2.0–3.7), though male gender (OR 1.5, 95%CI 1.2–1.9) was also predictive of assault injury, and a school setting was protective (OR 0.5, 95%CI 0.4–0.7).

4. Discussion

This study reveals specific patterns of injury based upon age and gender, and to a lesser extent, on season. We saw a substantial number of very young children (0–5 years), and a 2:1 ratio of males to females getting injured, which correlates to other studies within sub-Saharan Africa, such as Mozambique, and the Gambia.[4,17]

The predominance of injuries related to falls and burns are also similar to other regions throughout Malawi and the African continent.[7,14,17–22] By stratifying age and gender, we were able to observe patterns which suggest that certain populations should remain a focus for prevention programs. For example, both males and females sustained injuries at home and along the road, but males were five times more likely to have sports related injuries than females. Likewise, females and small children sustain a higher percentage of burn injuries, and most are in the home. This is a similar pattern seen in most undeveloped countries, which rely so heavily on floor level, open fire cooking.[23] By quantifying this burden of disease we can advocate for targeted prevention programs.

We also found that older children and adolescents are at higher risk of sustaining assault or pedestrian accidents. A survey of primary students at a public school in Blantyre, Malawi revealed that 97% of students walked to school every day.[19] Better lighting along roads, dedicated pedestrian lanes or sidewalks, and education about road safety, and protection from assault would be appropriate prevention initiatives. Adolescents were half as likely to get assaulted at school, and more likely to be assaulted at night. This trend could be affected by media campaigns via the radio and cell phones, educating adolescents on behavioral changes that could increase their safety.

Our research substantiates findings from other regions within Malawi,[18–20] and places the Malawi public health community in a good position to advocate with health policy leaders and the Ministry of Health for the most effective allocation of resources for pediatric injury prevention. These would include home-based safety initiatives, since 66% of the injuries occurred in the home, as well as to focus on burn and fall prevention. Programs can target communities prior to the cold season, when the use of fires in and around the home increases, and educate children and parents on fire safety. Fruits such as mangos are harvested between November and March in Malawi. Children typically attempt to climb trees during this season, searching for ripe fruit.[24] This provides an opportunity to educate children and parents on the risks and consequences of falls and fractures. In a study by Muula et al., as many as 86% of Malawian children report having fallen from a tree, 51% of which result in injury.[19] Public health prevention strategies based on the haddon matrix[25] could include the local manufacturing of a simple device to get mangos from trees without having to climb to great heights. Gupta et al. even advocates for a hook or clipper on the end of a stick.[24] With the high prevalence, and devastating consequences of burn injury in Malawi,[20,26] creation and distribution of enclosed cook stoves made from local brick and mud would be a cost-effective preventive measure. Several organizations in Malawi have begun marketing and distributing such a stove, but with more ecologic motives, and have not yet included a burn education component.[27,28]

ORIGINAL RESEARCH

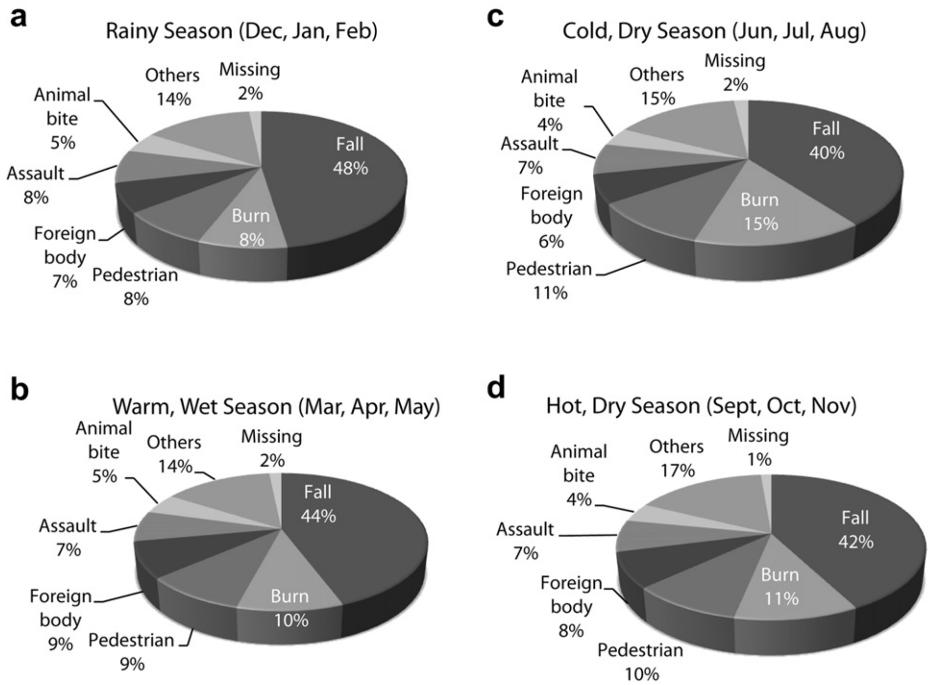

Fig. 3. Pie charts reflecting the distribution of injury mechanism by season, (a) rainy season (Dec, Jan, Feb), (b) warm, wet season (Mar, Apr, May), (c) cold, dry season (Jun, Jul, Aug), and (d) hot, dry season (Sept, Oct, Nov).

We were limited in our ability to make population-based burden of disease (BoD) assessments, as our data are hospital-based. Our odds ratios therefore represent the odds of sustaining a particular injury within a population of patients presenting to our hospital, and not the general population at large. Also limiting our ability to calculate BoD from our dataset is the lack of outcomes. The data are based upon information obtained at the initial evaluation. Information on morbidity and mortality remain a focus for future analysis.

Children are not just small adults. Their physical and cognitive abilities, degrees of dependence, activities and risk behaviors all change substantially as they grow older. As children develop, their curiosity and wish to experiment are not always matched by their capacity to understand or to respond to danger. This belies the changing characteristics of injury pattern across age cohorts and between children and adults. Health care systems with successful pediatric injury prevention programs must recognize these unique aspects in all facets of injury prevention including data surveillance, research, regulations and legislation, safety education and injury prevention campaigns and the commitment of health policy leadership to safety. These characteristics are rare in LMIC, but a step wise approach in developing a trauma care system will ultimately embrace the above mentioned characteristics.

Table 4
Association of season and injury characteristics.

Injury characteristics	Percent season 1 (Dec, Jan, Feb) ($n = 1642$)	Percent season 2 (Mar, Apr, May) ($n = 1546$)	Percent season 3 (Jun, Jul, Aug) ($n = 1790$)	Percent season 4 (Sept, Oct, Nov) ($n = 2221$)	*p* value
Injury mechanism					
Fall	47.6% (782)	44.3% (685)	39.7% (711)	42.3% (939)	<0.001
Burn	8.3% (136)	9.8% (151)	15.0% (268)	10.9% (241)	<0.001
Pedestrian	8.5% (139)	9.5% (147)	10.6% (190)	9.9% (220)	0.19
Foreign body	6.9% (114)	8.5% (132)	6.4% (114)	7.9% (175)	0.08
Assault	7.8% (128)	7.2% (112)	6.8% (121)	7.1% (158)	0.7
Animal bite	4.9% (80)	4.8% (74)	4.1% (74)	4.2% (94)	0.6
Others	14.4% (236)	14.3% (221)	15.6% (279)	16.4% (364)	
Missing	1.6% (26)	1.6% (24)	1.8% (33)	1.3% (28)	
Injury setting					
Home	67.5% (1109)	65.1% (1007)	64.2% (1149)	66.9% (1486)	0.06
Road	12.2% (200)	14.3% (221)	17.3% (309)	15.9% (352)	<0.001
School	5.1% (83)	5.5% (85)	5.3% (95)	5.1% (114)	0.9
Sport	2.6% (42)	2.5% (38)	1.6% (28)	1.5% (33)	0.02
Others	3.2% (53)	4.1% (91)	2.8% (50)	3.8% (84)	
Missing	9.4% (155)	8.5% (132)	8.8% (158)	6.8% (150)	
Transport type					
Minibus	43.1% (707)	43.1% (667)	38.6% (690)	38.5% (854)	0.003
Private vehicle	34.5% (567)	31.8% (491)	31.3% (561)	34.5% (767)	0.06
Ambulance	12.6% (206)	13.8% (212)	15.2% (272)	16.3% (362)	0.005
Walked	6.3% (103)	7.4% (115)	9.7% (173)	6.5% (144)	<0.001
Others	2.5% (41)	3.5% (54)	3.6% (64)	2.8% (62)	
Missing	1.0% (17)	0.4 (6)	1.6% (29)	1.4% (30)	

Table 5
Adjusted odds ratios and confidence intervals for predictors of the five most common injury mechanisms.

Injury mechanism	Predictor	Adjusted odds ratio (95%CI)	*p* value
Fall			
	Age 6–10 years	1.4 (1.3–1.6)	<0.001
	Male gender	1.3 (1.1–1.4)	<0.001
	Home setting	2.6 (2.3–2.9)	<0.001
	Rainy season (Dec, Jan, Feb)	1.2 (1.1–1.4)	0.004
	Daytime (8 am–6 pm)	1.8 (1.6–2.0)	<0.001
Burn			
	Age 0–5 years	4.0 (3.4–4.8)	<0.001
	Female gender	1.3 (1.1–1.5)	0.002
	Cold, dry season (Jun, Jul, Aug)	1.6 (1.3–1.9)	<0.001
	Home setting	7.3 (5.0–10.6)	<0.001
Pedestrian RTI			
	Age 6–10 years	1.4 (1.1–1.8)	0.007
	Road setting	50.9 (40.5–63.9)	<0.001
	Female gender	1.4 (1.1–1.7)	0.003
Foreign body			
	Age 0–5 years	2.1 (1.7–2.6)	<0.001
	Female gender	1.5 (1.2–1.7)	<0.001
	Home setting	3.8 (2.7–5.4)	<0.001
	Daytime (8 am–6 pm)	1.3 (1.0–1.6)	0.02
Assault			
	Age 11–16 years	4.9 (4.0–6.0)	<0.001
	Male gender	1.5 (1.2–1.9)	<0.001
	Nighttime	2.7 (2.0–3.7)	<0.001
	School setting	0.5 (0.4–0.7)	<0.001

Trauma registries are a tool to collect surveillance data that can be used to assess the effectiveness of the trauma system.[16,29] Such registries also inform researchers and public health officials about injury patterns, and help to establish priorities related to research, treatment, and prevention.[30] Cause-specific data for pediatric trauma is lacking in sub-Saharan Africa; therefore, pediatric injury prevention efforts do not receive an appropriate level of resources.[31,32] Surveillance and injury control programs must also be implemented to monitor and alleviate pediatric trauma, with the understanding that programs in high income countries can rarely be automatically applied to less developed regions.[12] In the United States (US), the focus of prevention programs might be on helmet and seatbelt use, with the most common and severe pediatric injuries resulting from motor vehicles, motorcycles and ATVs.[33] Or prevention of firearm injuries may be a focus in the US, where 20,600 firearm-related injuries require medical attention annually.[34] In comparison, Malawi is a nation which has not experienced war or the proliferation of firearms, and this was represented in our data, which had zero recorded assaults due to firearms. By evaluating the pattern of pediatric injury specific to Malawi, we are better able to design injury prevention strategies and implement programs which target differing groups of high injury risk populations, at the right time, and in the most effective way.

Disclosures

The authors would like to disclose that there are no conflicts of interest associated with this research or the completion of this manuscript.

Ethical approval

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Authors contributions

Michelle Kiser—study design, data collection and analysis, writing.
Anthony Charles—study design, writing.
Jonathan Samuel—study design, data collection, writing.
Sean Mclean—writing.
Arturo Muyco—study design, writing.
Bruce Cairns—writing.

Conflicts of interest

None.

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